Ellerbe Creek
Watershed Management Improvement Plan

PUBLIC WORKSHOP
November 19, 2009

BROWN AND CALDWELL

Meeting Agenda

- Project Overview
- Riparian Area Management Plan (RAMP)
- Critical Area Protection Plan (CAPP)
- Better Site Design and LID
- Pollutant Reduction Goals
- Pilot Study Area Evaluations
- Watershed Evaluation
- Preliminary Recommendations

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Project Overview

- Public Meeting #1 – April 2008:
  - Brief overview of project goals
  - Review of project schedule
  - Description of initial tasks (e.g., stream assessments, BMP inventories)
  - Presentation and prioritization of evaluation criteria, with public feedback

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Project Overview

- Public Meeting #2 – October 2008:
  - Discussion of evaluation criteria, including scoring range and weighting factors
  - Draft Critical Area Protection Plan
  - Selection and description of five Pilot Study Areas
  - Overview of watershed evaluation methods, including GIS-based water quality model (WIP Tools model)

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Riparian Area Management Plan (RAMP)

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Riparian Area Management Plan

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- Developed for management and maintenance of riparian areas on City-owned property, documenting:
  - Vegetation maintenance guidelines for City staff
    - Greenway corridors, utility easements, and parks
    - Fact Sheets to help explain recommended practices
  - Water quality and ecological benefits of the riparian areas
  - Planning and design guidance for managers and engineers

Fact Sheets

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Riparian Area Management Fact Sheet

Parks and Greenways

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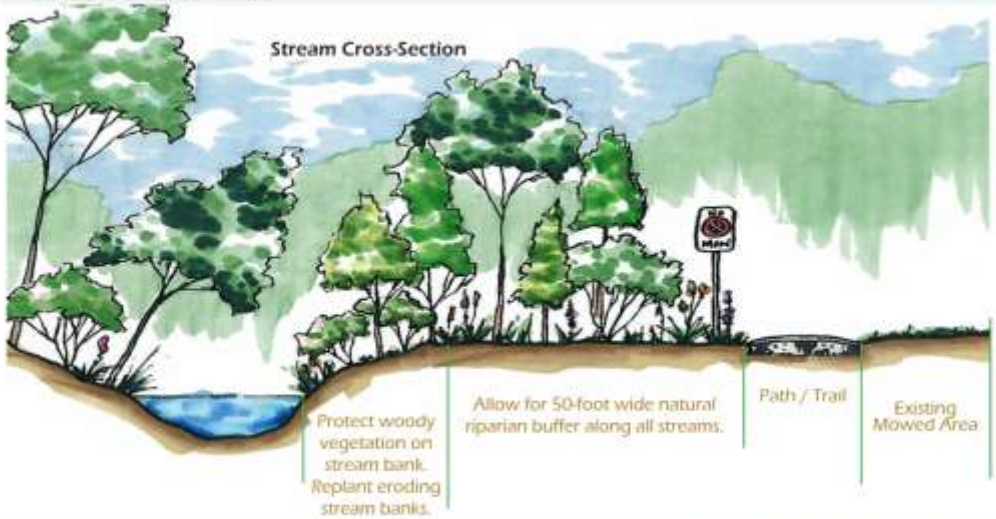
1. Protect woody vegetation on stream banks. Stabilize eroding stream banks with native vegetation. Do not apply herbicides (except for invasive species control by a licensed applicator).
2. Protect existing vegetated riparian buffers (50-foot width minimum). Plant cleared riparian areas with native vegetation and install "No Mow" signs.
3. Alternate mowing patterns every 3-4 years when a continuous buffer is not desired.
4. Protect the vegetated buffer (50-foot width preferred) on smaller tributaries and swales. Do not apply herbicides (except for invasive species control by a licensed applicator).
5. Mow park less frequently and set mowing deck as high as possible.
6. Retrofit existing stormwater drainage outfalls with level spreaders.
7. Install "No Mow" signs along the edges of the riparian buffers.
8. Blow leaves from mowed areas into established buffers. When possible, create brush piles in established buffers to enhance habitat.



Riparian Area Management Plan

- Next Steps:
  - Coordination with other City Departments to solicit feedback
  - Educate maintenance crews on recommended practices
  - Implement and revise over time as new situations arise

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Critical Area Protection Plan (CAPP)

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Critical Area Protection Plan

- Critical areas for protection were identified using 17 site characteristics based upon:
  - Existing site conditions (forested)
  - Water quality and ecological benefits
  - Connectivity to other protected natural resources
- Criteria were gathered from:
  - Upper Neuse River Clean Water Initiative
  - Ellerbe Creek Local Watershed Plan
  - Durham Trails Master Plan
  - Falls Lake Initiative Conservation Plan
  - Land use data to identify vacant land that is both privately and publicly-owned
  - Supplemental information obtained during the stream field inventory

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Critical Area Protection Plan

- 202 properties met the criteria for “key” properties
- Initial focus for acquisition or protection will be in eight areas of the watershed
- 50 additional properties were identified as “urban gems” due to public feedback

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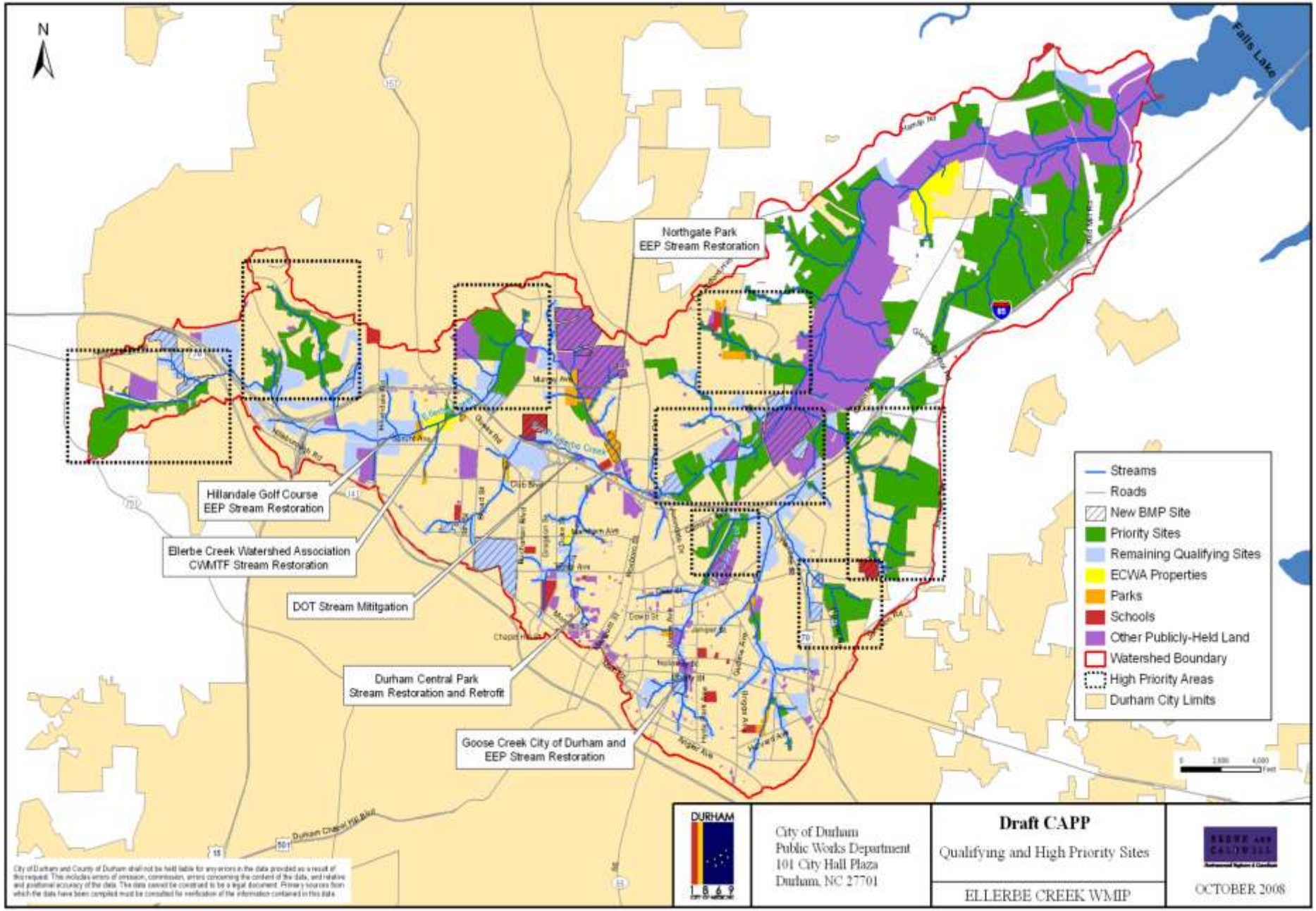
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Falls Lake
Northgate Park
EEP Stream Restoration
Hillandale Golf Course
EEP Stream Restoration
Ellerbe Creek Watershed Association
CWMTF Stream Restoration
DOT Stream Mititgation
Durham Central Park
Stream Restoration and Retrofit
Goose Creek City of Durham and
EEP Stream Restoration
Streams
Roads
New BMP Site
Priority Sites
Remaining Qualifying Sites
ECWA Properties
Parks
Schools
Other Publicly-Held Land
Watershed Boundary
High Priority Areas
Durham City Limits
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Draft CAPP
Qualifying and High Priority Sites
ELLERBE CREEK WMIP
OCTOBER 2008

Better Site Design and Low Impact Development (LID)

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What is Better Site Design?

- Aims to mitigate the impacts to land and water from development activities
- Approach emphasizes the integration of site design and planning techniques with low impact development measures (LID) that conserve the natural areas and hydrologic functions of a site.
- Site design and LID measures can be non-structural (cluster development) or structural (green roof)

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Better Site Design – Important Factors

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- Anticipated land use changes:
  - Only 20% of the watershed is undeveloped or expected to undergo significant redevelopment
  - Significantly limits opportunities for better site design and LID
- Soil characteristics:
  - Permeability is key since most LID measures rely on infiltration
  - Most soils found in Durham have low permeability or have been highly modified during development

Better Site Design – Important Factors

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- Depth to groundwater:
  - If water table is within 3 feet of surface, infiltration is greatly reduced
  - Low-lying areas
- Ground Slope:
  - Difficult to incorporate LID and better site design measures on steep slopes
  - Slopes greater than 5% are widespread and can limit feasibility of LID measures

Recommended LID Measures for Durham

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- Non-structural site design measures feasible in Durham:
  - Cluster development
  - Minimizing areas of disturbance
  - Preserve sensitive resources (e.g., wetlands, streams, mature forests)
  - Minimize soil compaction

Recommended LID Measures for Durham

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- Structural LID measures feasible in Durham:
  - Pervious Pavement, Bioretention, and Other Infiltration-based Measures:
    - Acceptable over permeable soils, which are limited (approx. 2500 acres within City of Durham)
    - Underdrains required for less permeable soils
  - Green Roofs
  - Green Streets
  - Cisterns and rain barrels
  - Native vegetation
  - Soil amendments

Pilot Study on Better Site Design

- 40% increase in industrial development
- 100% increase in residential development

Pilot Study Scenarios

Scenario	Implementation	Effectiveness
Baseline Scenario	Low	Low
“Likely” Scenario	Moderate	Moderate
Aggressive Enrollment	High	Moderate
Aggressive Runoff Reduction	Moderate	High
Aggressive Enrollment and Runoff Reduction	High	High

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Better Site Design and LID

Scenario	Effective Impervious Area*	Runoff Volume (million gals.)
Baseline Scenario	32%	24
"Likely" Scenario	30% (-6%)	23 (-4%)
Aggressive Enrollment	25% (-22%)	20 (-17%)
Aggressive Runoff Reduction	28% (-13%)	22 (-8%)
Aggressive Enrollment and Runoff Reduction	20% (-38%)	18 (-25%)

* Reductions in effective impervious area are based on a combination of infiltration/retention of stormwater runoff and reduced impervious areas

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Pollutant Reduction Goals

Pollutant Reduction Goals

- Total Nitrogen
  - 7.5 pounds per acre per year (pollutant yield)
- Total Phosphorus
  - 0.38 lbs/ac/yr
- Based on Interim Strategy for Falls Lake
  - 40% reduction of Total Nitrogen from existing (2006) yield
  - 77% reduction of Total Phosphorus from existing (2006) yield

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Pollutant Reduction Goals

- Sediment
  - 1600 lbs/ac/yr
  - Target based on metrics from the Northern Piedmont region in Georgia
- Fecal Coliform
  - $5.1 * 10^9$ CFUs/ac/yr
  - Target based on water quality standard of 200 CFUs per 100 mL and average annual flow measured in Ellerbe Creek by USGS

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Land Use Based Pollutant Yields

- Bold-highlighted pollutant yields exceed pollutant reduction goals
- Sediment yield represent land-use based loads; erosion within the stream channel are additional

Land Use Type	TN (lbs/ac/yr)	TP (lbs/ac/yr)	Sediment (lbs/ac/yr)	Fecal Coliform (cfu*10^9 /ac/yr)
Residential				
High Density	**8.6**	**0.7**	600	**9.1**
Medium Density	4.7	**1.0**	200	**9.1**
Low Density	2.4	0.3	50	**6.9**
Very Low Density	1.2	0.2	40	**6.9**
Commercial	**13.9**	**1.7**	860	2.7
Institutional	4.2	**0.7**	100	**9.1**
Industrial	**9.4**	**0.8**	750	2.7
Agriculture				
Animal Operations	**35.0**	**2.5**	1000	**75**
Pasture	**7.5**	**1.1**	200	**8.7**
Parks and Open Space	1.8	0.2	35	**7.9**
Roads and Right-of-Way	**9.3**	**1.7**	980	2.7

Pilot Study Area Evaluations

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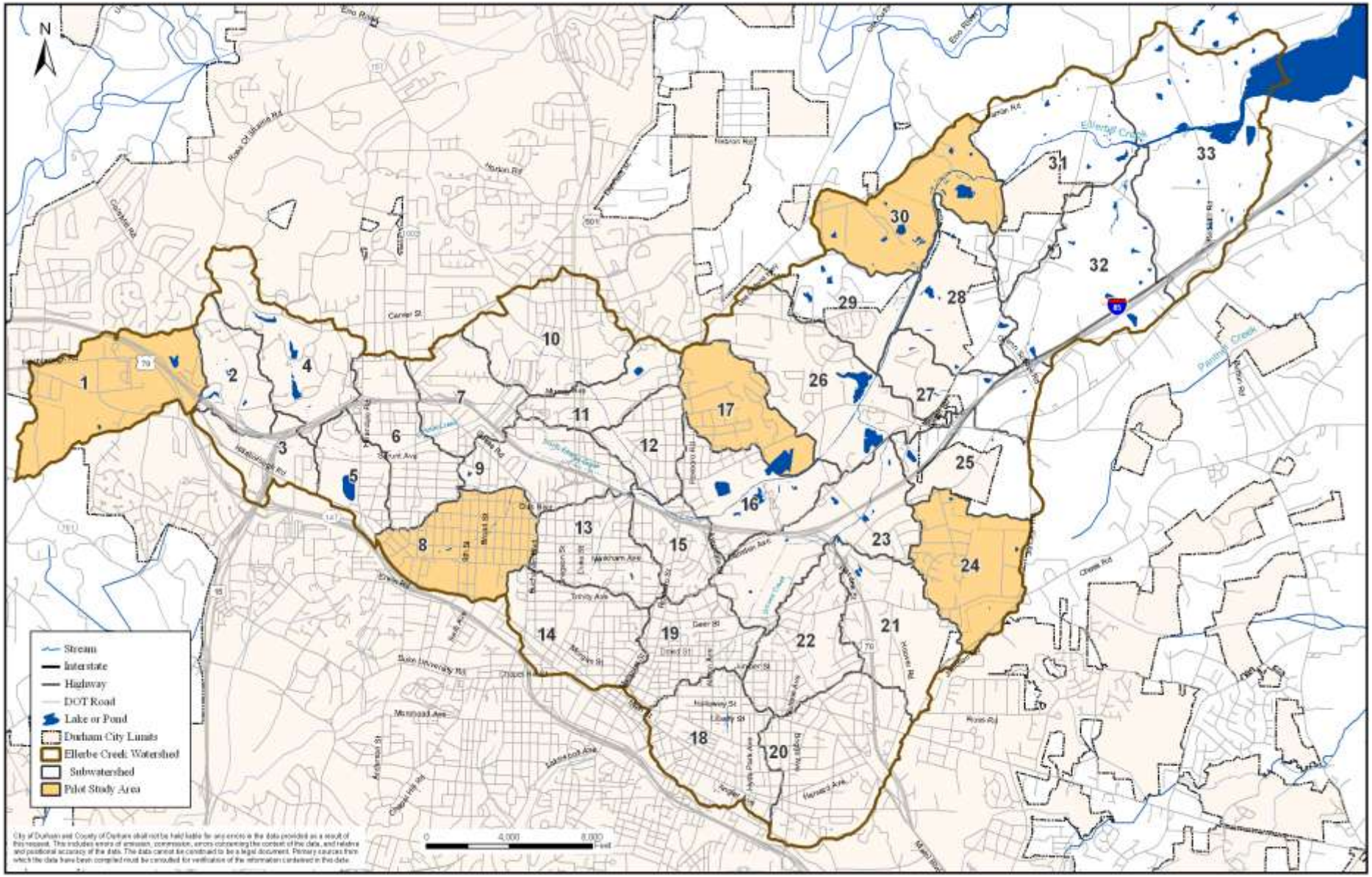
- Five Pilot Study Areas were selected to represent the typical conditions found throughout the watershed:
  - Subwatershed I: headwaters area
  - Subwatershed 8: densely developed urban core
  - Subwatershed I7: rapidly developing residential area
  - Subwatershed 24: rapidly developing area of residential, commercial, and industrial land
  - Subwatershed 30: rural, undeveloped

Pilot Study Area Evaluations



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- Hydrologic and hydraulic model (PCSWMM) was created for the watershed
- More detailed hydrologic and hydraulic models were generated for the five pilot study areas:
  - Integrated grading for stream restoration projects
  - Incorporated storage volume and outlet control structures for stormwater quality BMPs

Pilot Study Area Evaluations

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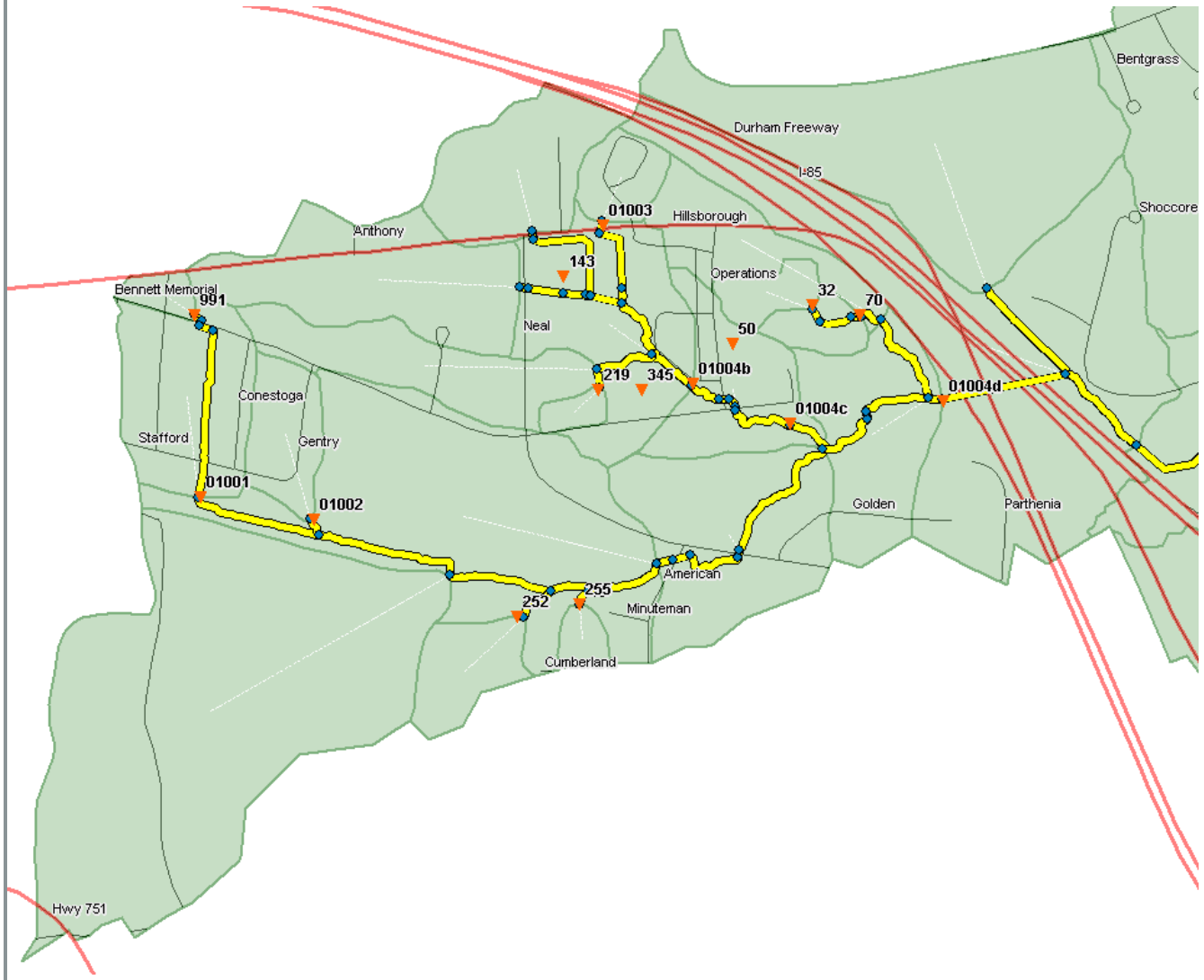

Pilot Study Area Evaluations

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- Each recommended BMP retrofit, new BMP, and stream restoration project was analyzed using this detailed model:
  - Conceptual design was prepared
  - Grading and outlet structures were inserted for BMPs
  - Verified detention time and water surface elevations
  - Evaluated opportunities to provide multiple benefits
    - Only 12 BMPs can accommodate both the water quality and channel protection runoff volumes

Pilot Study Area Evaluations

- Question: How effective can we be at reducing pollutant yield within Ellerbe Creek based on the results within the Pilot Study Areas?

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Pilot Study Area Evaluations

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- Step I: Develop model of each potential project was analyzed as a stand-alone project
- Step 2: Identify "efficient" projects:
  - Evaluate $ per pound removed for each pollutant
  - Total possible water quality score = 35
  - If WQ score > I7 (~50% of the total), then project is efficient at reducing targeted pollutants

Pilot Study Area Evaluations

- Step 3: Identify the "group" of feasible projects within each PSA
- Step 4: Generate the combined water quality benefits of the feasible projects for each PSA

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Pilot Study Area Evaluations

- Percent yield reductions based on PSA evaluations

PSA	Total Nitrogen	Total Phosphorus	Sediment	Fecal Coliform
1	20%	20%	37%	13%
8	8%	12%	18%	<1%
17	3%	3%	3%	<1%
24	10%	15%	28%	1%
30	-	-	-	-

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Pilot Study Area Evaluations

- Step 5: Assign similar water quality benefits to remaining subwatersheds based on representative watershed conditions

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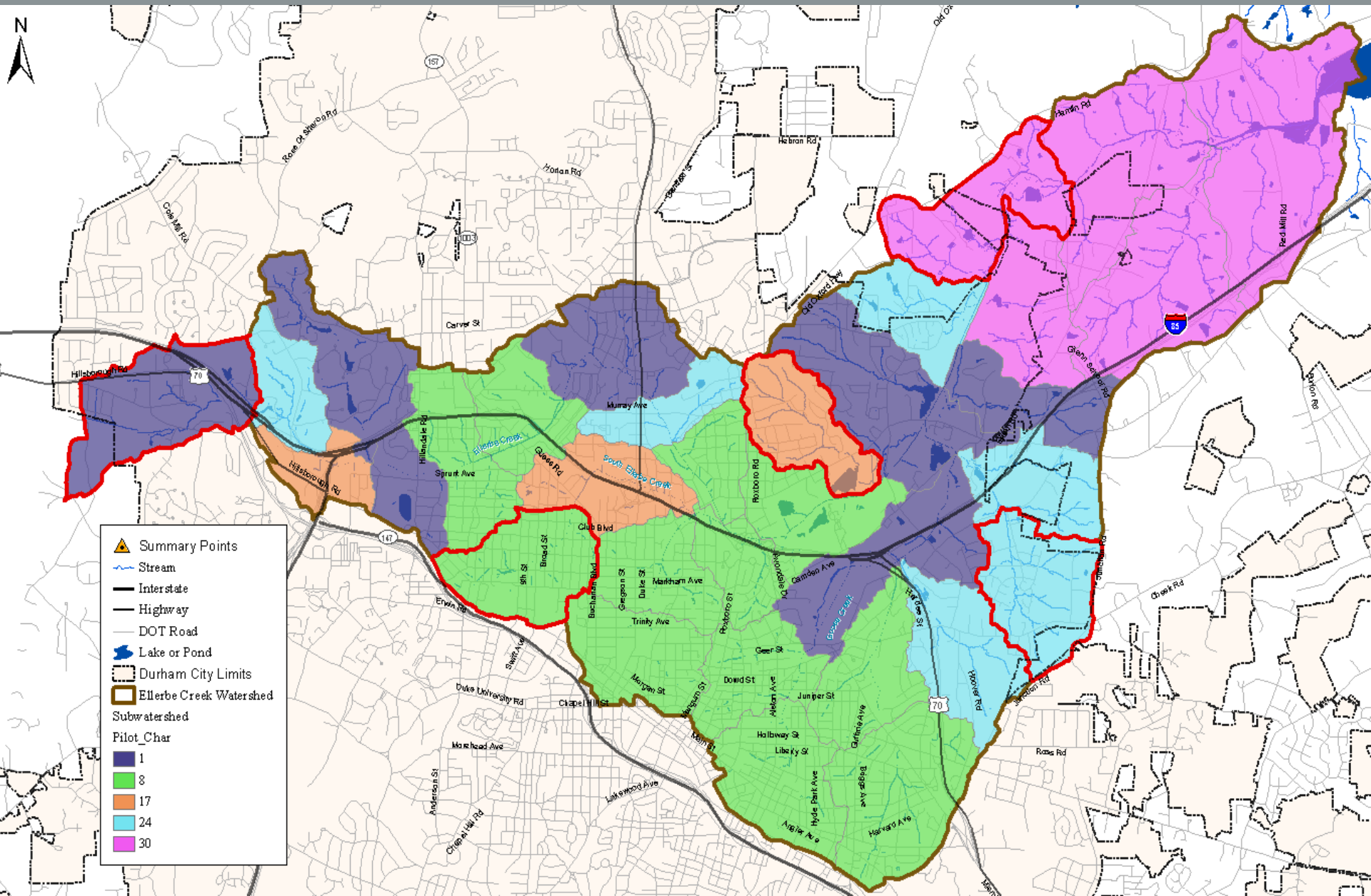
Pilot Study Area Assignments



Watershed Scenario Evaluations

Watershed Scenarios

- "Watershed Scenario" represents a combination of point source and non-point source controls aimed at improving water quality and watershed function:
  - BMP retrofits
  - New BMPs
  - Stream restoration projects
  - On-site controls for new development
  - Replacement/rehabilitation of sanitary sewers
  - Upgrades to the North Durham WWTP
  - Low Impact Development (LID) measures

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Watershed Improvement Plan (WIP) Tools Model

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- Functions:
  - Sediment, nutrient, and bacteria loadings to Ellerbe Creek and Falls Lake
  - In-stream production of sediment and nutrient loadings by stream reach
  - Water quality benefits of individual stream restoration projects and stormwater BMPs
  - Overall water quality benefits of multiple watershed management scenarios
  - Watershed-wide water quality conditions

Watershed Scenarios

Baseline Conditions:

- Scenario 1 – Baseline: No Existing BMPs
- Scenario 2 – Existing BMPs and Stream Conditions

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Scenario 2 – Existing Conditions

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Summary Points	Drainage Area (acres)	Nitrogen Yield (lbs/ac/yr)	Phosphorus Yield (lbs/ac/yr)	Sediment Yield (lbs/ac/yr)	Fecal Coliform Yield (10^9 cfu/ac/yr)
City Limits	13,057	**12.6**	**1.6**	**2,250**	**15.6**
Falls Lake	16,252	**10.8**	**1.3**	**2,000**	**12.7**

Goals:

- Nitrogen = 7.5 lbs/ac/yr (40% reduction from existing yield)
- Phosphorus = 0.38 lbs/ac/yr (77% reduction from existing yield)
- Sediment = 1,600 lbs/ac/yr
- Fecal coliform = 5.1 * 10^9 cfu/ac/yr

Watershed Scenarios

Non-Point Source Controls:

- Scenario 3 – All Potential Projects: Stream Restoration, New BMPs, and BMP retrofits (165 total projects)
- Scenario 4 – Pilot Study Areas
- Scenario 5 – Stormwater Performance Standards for Development
- Scenario 6 – LID plus Stormwater Performance Standards for Development
- Scenario 7 – Proprietary BMPs

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Watershed Scenarios

Point Source Controls:

- Scenario 8:
  - Sewer Rehabilitation Program
  - Nutrient removal upgrades at North Durham WWTP

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Fecal Coliform

- Minor improvements achieve by non-point source controls, primarily in the headwaters or in the tributaries to Ellerbe Creek
- Significant reductions if leaking/failing sewers (SSOs) are reduced

FECAL COLIFORM	
Scenario	Percent Reduction at Falls Lake
Scenario 2 Existing Conditions	2%
Scenario 3 All Projects	2%
Scenario 4 PSA Evaluations	3%
Scenario 5 Stormwater Performance Standards for Development	1%
Scenario 7 Proprietary Devices	10%
Scenario 8 Point Source Controls	57%

Sediment

- Primary hot spots where sediment exceeds goal are South Ellerbe Creek and Goose Creek, primarily due to poor conditions of the stream channels
- Stream Restoration projects and BMPs in the headwaters provide the most sediment removal
- Recommend implementation of stream restoration and BMP projects in South Ellerbe and Goose Creek

SEDIMENT	
Scenario	Percent Reduction at Falls Lake
Scenario 2 Existing Conditions	< 1%
Scenario 3 All Projects	15%
Scenario 4 PSA Evaluations	22%
Scenario 5 Stormwater Performance Standards for Development	3%
Scenario 7 Proprietary Devices	13%
Scenario 8 Point Source Controls	N/A

Total Phosphorus

- Majority of watershed does not meet goal of 0.38 lbs/ac/yr (Interim Strategy for Falls Lake)
- Non-Point and Point Source controls achieve limited results

TOTAL PHOSPHORUS	
Scenario	Percent Reduction at Falls Lake
Scenario 2 Existing Conditions	< 1%
Scenario 3 All Projects	4%
Scenario 4 PSA Evaluations	10%
Scenario 5 Stormwater Performance Standards for Development	5%
Scenario 7 Proprietary Devices	7%
Scenario 8 Point Source Controls	19%

Total Nitrogen

- Majority of the main stem of Ellerbe Creek below the North Durham WWTP does not meet goal of 7.5 lbs/ac/yr (Interim Strategy for Falls Lake)
- Non-Point and Point Source controls achieve limited results

TOTAL NITROGEN	
Scenario	Percent Reduction at Falls Lake
Scenario 2 Existing Conditions	< 1%
Scenario 3 All Projects	3%
Scenario 4 PSA Evaluations	8%
Scenario 5 Stormwater Performance Standards for Development	5%
Scenario 7 Proprietary Devices	5%
Scenario 8 Point Source Controls	4%

Non-Point and Point Source Controls Summary

SCENARIO RESULTS SUMMARY AT FALLS LAKE

Scenario	Cost ($Millions)	Reduction in Pollutant Yield (%)			
		Nitrogen	Phosphorus	Sediment	Fecal Coliform
Scenario 2 Existing Conditions	-	< 1%	< 1%	< 1%	2%
Scenario 3 All Projects	$130	3%	4%	15%	2%
Scenario 4 PSA Evaluations	$220 - $260	8%	10%	22%	3%
Scenario 5 Stormwater Performance Standards for Development	Private	5%	5%	3%	1%
Scenario 7 Proprietary Devices	$100 - $110	5%	7%	13%	10%
Scenario 8 Point Source Controls	$35 - $50	4%	19%	N/A	57%

Watershed Scenarios

Combined Scenarios:

- Scenario 9 – Maximize Non-Point Source Controls:
  - Reductions based on Pilot Study Area Evaluations
  - Better Site Design and LID
  - Proprietary Devices
  - Stormwater Performance Standards for Development

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Scenario 9 Results

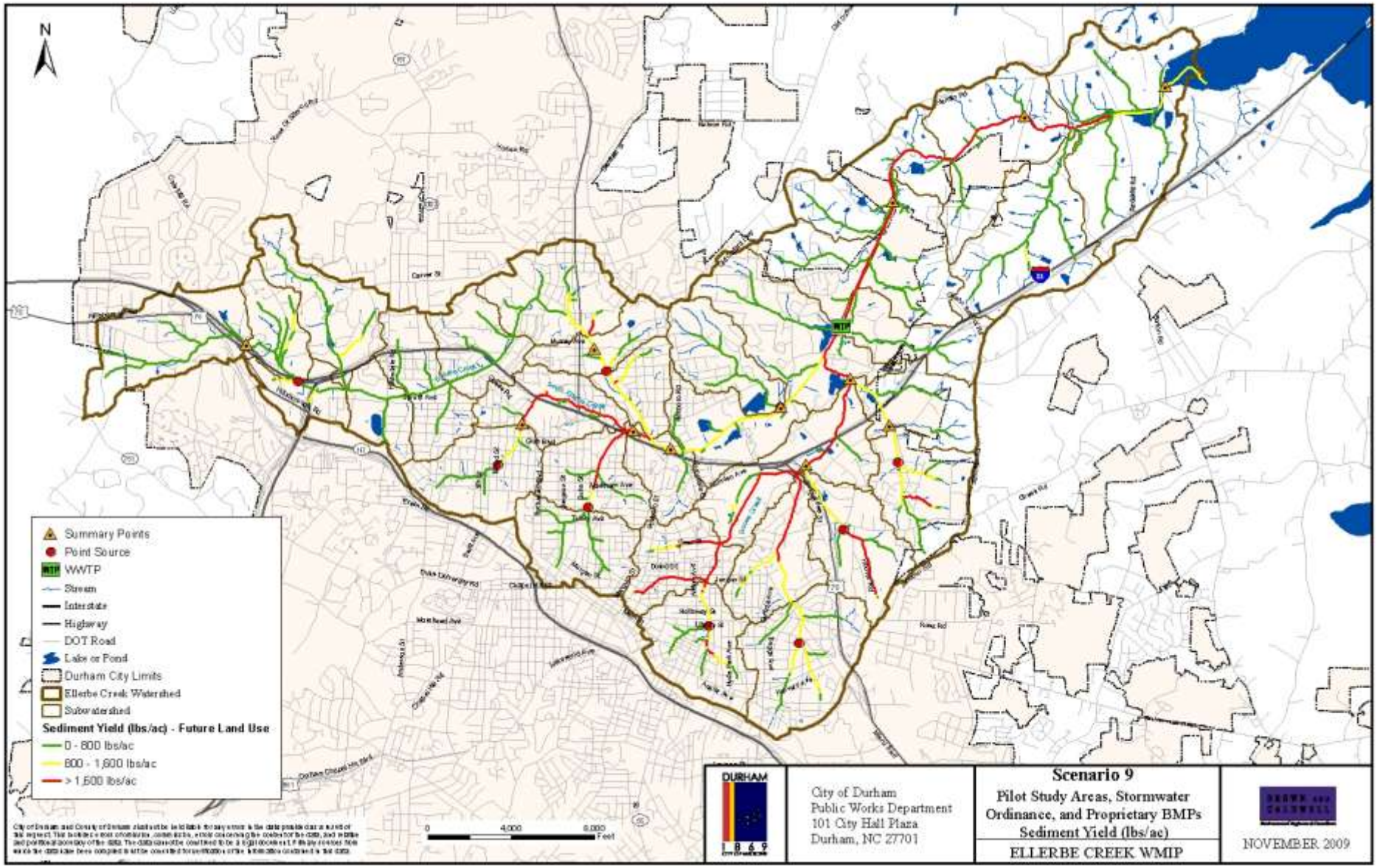
SCENARIO 9 RESULTS AT FALLS LAKE

Scenario	Cost ($Millions)	Pollutant Yield			
		Nitrogen Yield (lbs/ac/yr)	Phosphorus Yield (lbs/ac/yr)	Sediment Yield (lbs/ac/yr)	Fecal Coliform Yield (10^9 cfu/ac/yr)
Scenario 2 Existing Conditions	-	**10.8**	**1.3**	**2,000**	**12.7**
Scenario 9 Combined Non-Point Source Controls	$320 to $370	**9.4** (-13%)	**1.1** (-15%)	1,550 (-23%)	**12.0** (-6%)

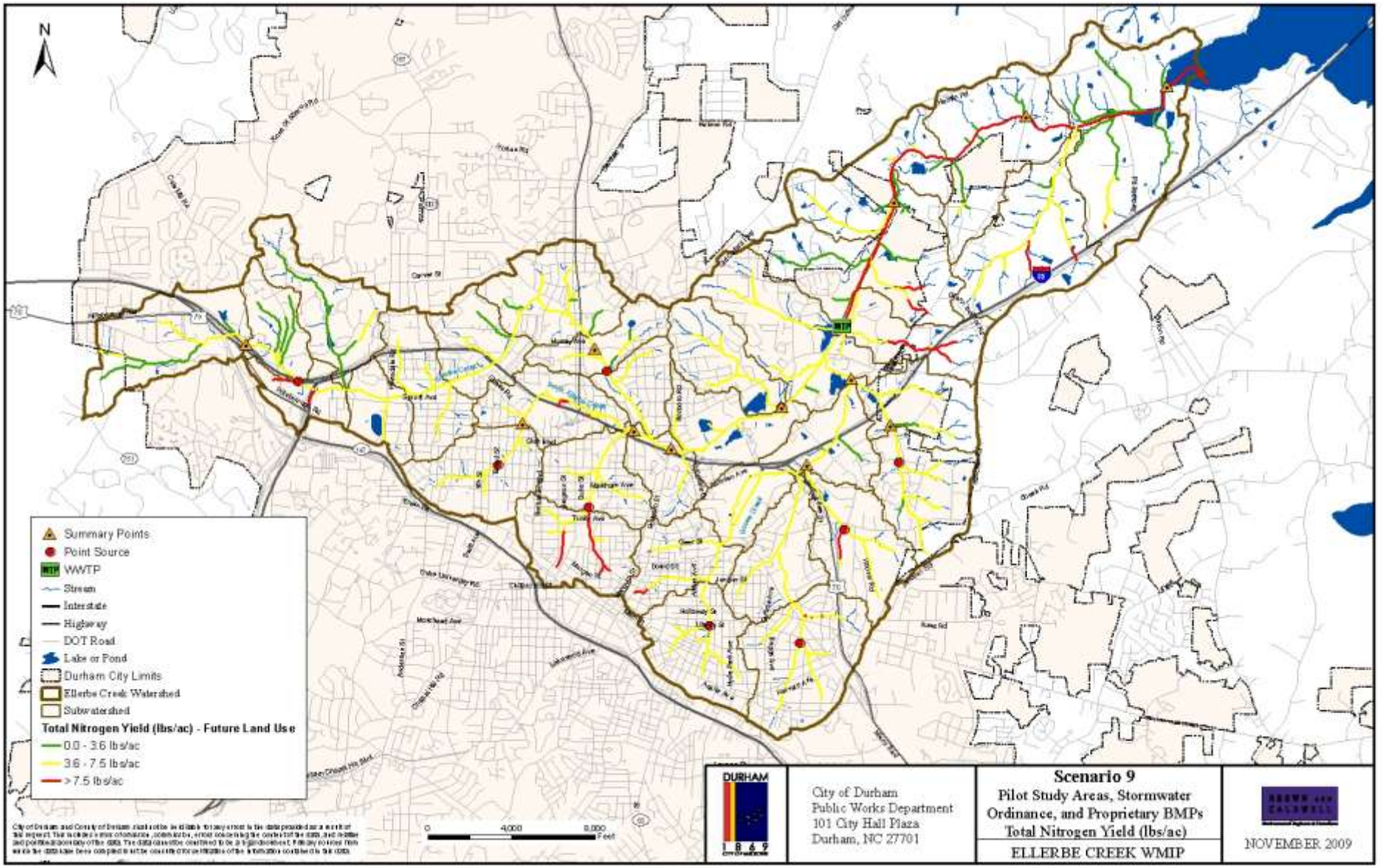
Goals:

- Nitrogen = 7.5 lbs/ac/yr (40% reduction from existing yield)
- Phosphorus = 0.38 lbs/ac/yr (77% reduction from existing yield)
- Sediment = 1,600 lbs/ac/yr
- Fecal coliform = 5.1 * 10^9 cfu/ac/yr

Sediment Yield Results for Scenario 9



Nitrogen Yield Results for Scenario 9



Watershed Scenarios

Combined Scenarios:

- Scenario 10 – Point and Non-Point Source Controls:
  - Non-Point Source Controls in Scenario 9
  - Sewer Rehabilitation Program
  - Nutrient removal upgrades at North Durham WWTP

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Scenario 10 Results

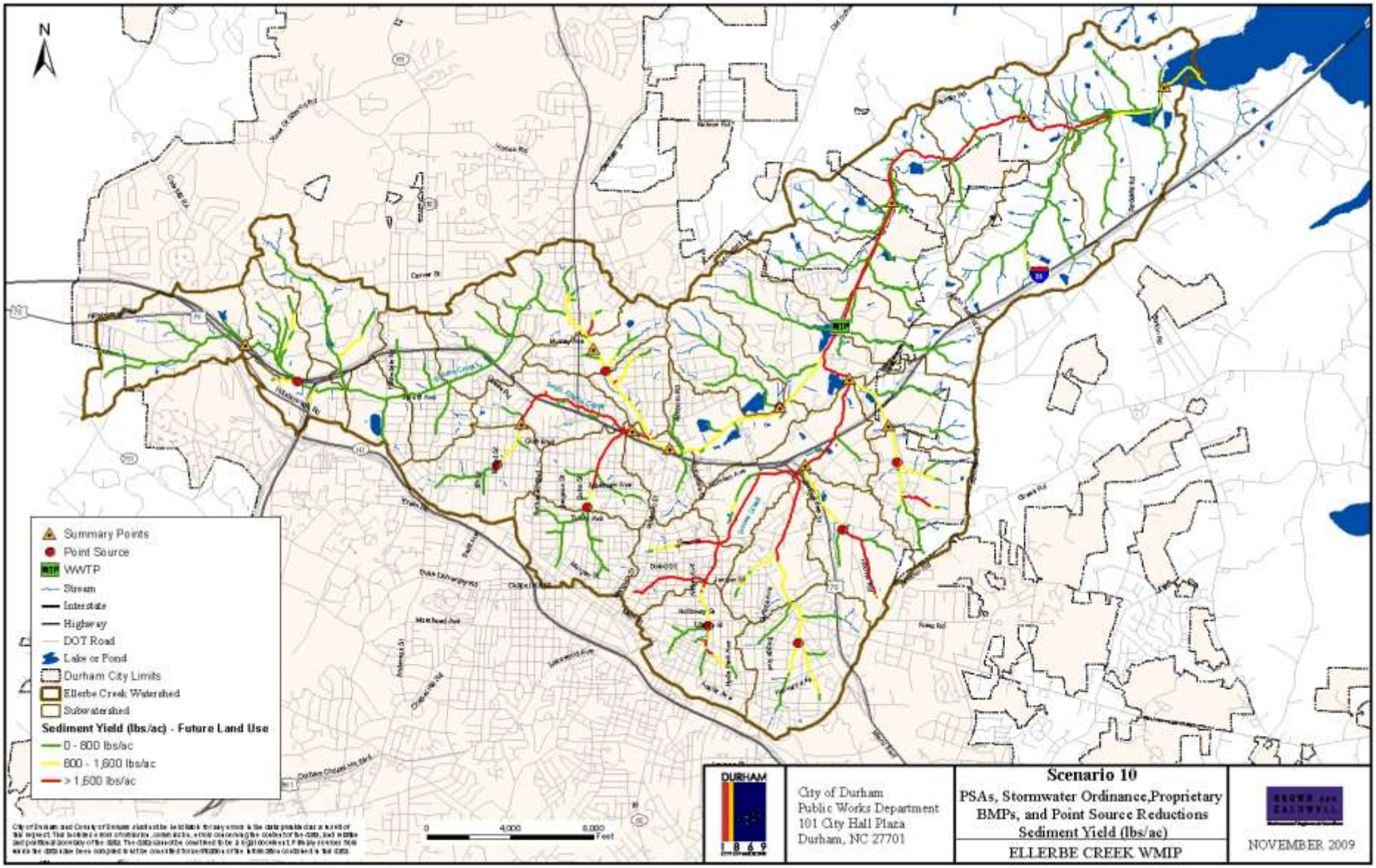
SCENARIO 10 RESULTS AT FALLS LAKE

Scenario	Cost ($Millions)	Pollutant Yield			
		Nitrogen Yield (lbs/ac/yr)	Phosphorus Yield (lbs/ac/yr)	Sediment Yield (lbs/ac/yr)	Fecal Coliform Yield (10^9 cfu/ac/yr)
Scenario 2 Existing Conditions	-	**10.8**	**1.3**	**2,000**	**12.7**
Scenario 10 Combined Non-Point Source and Point Source Controls	$360 to $420	7.4 (-31%)	**0.9** (-34%)	1,550 (-23%)	4.7 (-63%)

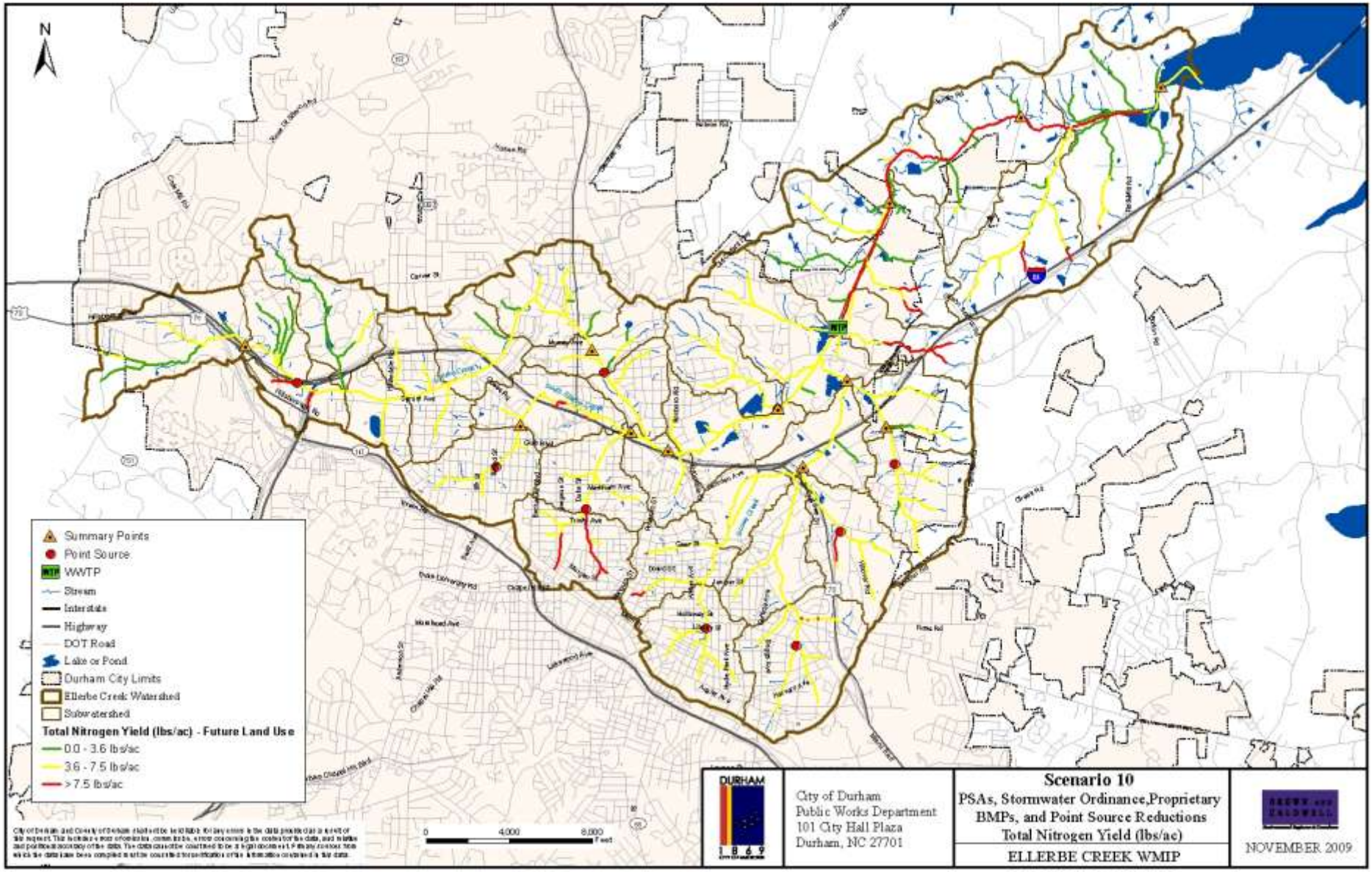
Goals:

- Nitrogen = 7.5 lbs/ac/yr (40% reduction from existing yield)
- Phosphorus = 0.38 lbs/ac/yr (77% reduction from existing yield)
- Sediment = 1,600 lbs/ac/yr
- Fecal coliform = 5.1 * 10^9 cfu/ac/yr

Sediment Yield Results for Scenario 10



Nitrogen Yield Results for Scenario 10



Preliminary Recommendations for Watershed Improvement Plan

BROWN AND CALDWELL

Preliminary Recommendations

I. Implement Point Source Controls:
   a. On-going sewer rehabilitation and replacement program
   b. Upgrade nutrient control technology at North Durham WWTP

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Preliminary CIP Recommendations

2. Implement BMP retrofits and new BMPs
   a. Acquire new BMP sites
   b. Implement high-priority BMPs based on water quality efficiency and overall score for evaluation criteria

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Preliminary CIP Recommendations

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3. Implement Stream Restoration Projects based on water quality efficiency and overall score for prioritization criteria, focused on these areas:
   a. South Ellerbe Creek
   b. Goose Creek
   c. Main stem of Ellerbe Creek downstream of Roxboro St.

Preliminary Recommendations

4. Implement recommendations in Riparian Area Management Plan (City-wide) and the Critical Area Protection Plan for Ellerbe Creek Watershed

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Next Steps

1. Prepare Final Watershed Improvement Plan:
   a. 5-year CIP for Ellerbe Creek
   b. Prepare draft report for public review
   c. Prepare final report
2. Complete Rate Study (currently underway) to evaluate current and project stormwater utility rates to adequately fund the City-wide Stormwater Management Program

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Next Steps

3. Coordinate with Water Department:
   a. Continue sewer rehabilitation and replacement program
   b. Implement upgrades to North Durham WWTP
4. Implement high-priority BMPs and stream restoration projects (based on available funding)
5. Implement RAMP and CAPP

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Next Steps

6. Re-evaluate watershed scenarios as Falls Lake strategy develops
7. Continue to investigate additional strategies for treating existing and new development, such as water reuse, soil amendments, volume reduction devices, green infrastructure techniques, etc.

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Thank You!

Questions?